

Review

# Designing the Business Models for Circular Economy—Towards the Conceptual Framework

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**Abstract:** Switching from the current linear model of economy to a circular one has recently attracted increased attention from major global companies e.g., Google, Unilever, Renault, and policymakers attending the World Economic Forum. The reasons for this are the huge financial, social and environmental benefits. However, the global shift from one model of economy to another also concerns smaller companies on a micro-level. Thus, comprehensive knowledge on designing circular business models is needed to stimulate and foster implementation of the circular economy. Existing business models for the circular economy have limited transferability and there is no comprehensive framework supporting every kind of company in designing a circular business model. This study employs a literature review to identify and classify the circular economy characteristics according to a business model structure. The investigation in the eight sub-domains of research on circular business models was used to redefine the components of the business model canvas in the context of the circular economy. Two new components—the take-back system and adoption factors—have been identified, thereby leading to the conceptualization of an extended framework for the circular business model canvas. Additionally, the triple fit challenge has been recognized as an enabler of the transition towards a circular business model. Some directions for further research have been outlined, as well.

**Keywords:** business models; circular economy; circular business model; sustainable business model; business model design

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## 1. Introduction

Switching from the current linear model of economy to a circular one would not only bring savings of hundreds of billions US dollars to the EU alone, but also significantly reduce the negative impact on the natural environment [1,2]. This is why the circular economy (CE) has attracted increased attention as one of the most powerful and most recent moves towards sustainability [3,4]. The transition to the circular economy entails four fundamental building blocks—materials and product design, new business models, global reverse networks, and enabling conditions [5]. Switching an economy to a circular one depends, on the one hand, on policymakers and their decisions [6]; on the other hand, it depends on introducing circularity into their business models by business entities [7]. The scope of interest of this study is limited to the latter, micro-level perspective of designing circular business models.

Comprehensive knowledge on designing circular business models is needed to stimulate and foster implementation of the circular economy on a micro-level. Existing knowledge provides several well-elaborated and verified frameworks of business models, design patterns and tools to build a business model [8,9]. Although many case studies revealed several types of circular business actions

or models [4,7], these models have limited transferability. There are very few studies covering, in a more comprehensive manner, how a circular business model framework should look. Previous research instead has taken the following approaches: building on a business model canvas (BMC) and classifying the product-service system characteristics according to its structure [10]; significantly reconstructing the BMC into a business cycle canvas to support practitioners in thinking in business systems and beyond the individual business model [11]; using it as a part of a bigger framework of a business model limited to eco-innovation [12]; or extending it to encompass wider social perspectives of costs and benefits [13]. Other studies provide some steps for analyzing an existing business model for potential opportunities to introduce circularity [7,14].

None of these reviewed studies have provided satisfactory answers to the following questions: How may the principles of the circular economy be applied to a business model? What components should a circular business model consist of to be applicable to every company? This study considers the circular economy as a new contribution to the development of business model theory. Because changing a company's business model into a circular one is challenging, the following research provides a conceptual framework of the circular business model to support practitioners in the transition process from linear business models to more circular ones.

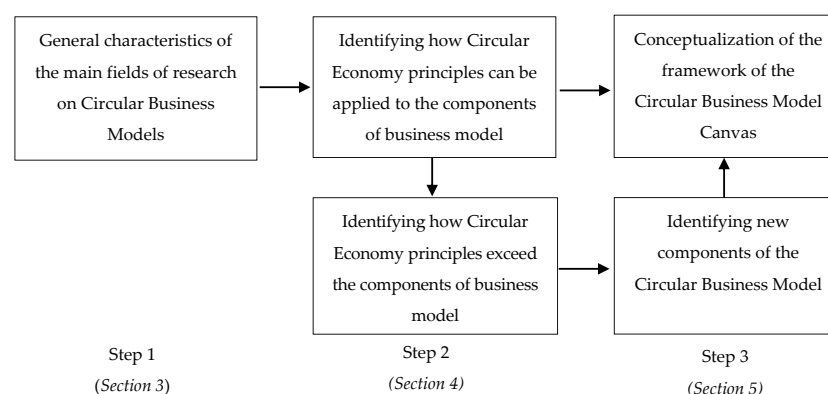
The paper is structured as follows. Section 2 presents the concept of this study and methodological remarks. Section 3 identifies the specificity of circular business models according to the eight sub-domains of research in the area of business models proposed by Pateli and Giaglis [15]. Section 4 classifies the findings of the review according to the business model framework developed by Osterwalder and Pigneur [8]. Thus, the nine building blocks of a business model framework are characterized in the context of the circular economy. This section reveals the need to extend the business model framework to make it more applicable to the circular economy. Section 5 provides a proposition to address this need and presents a conceptualization of an extended framework of business model—the circular business model canvas (CBMC). Section 6 provides suggestions for future research. Section 7 presents the conclusions of the study.

## 2. The Method and Concept of the Study

In order to answer the questions how the principles of the circular economy can be applied to a business model, and which universally applicable components are needed for a circular business model, a narrative conceptual review has been employed.

The process was divided into three steps.

- (1) Identification of the state of the art on business models in the CE (circular business models)
- (2) Categorization of the initial body of literature according to the components of business model structure
- (3) Synthesis and development of the framework for a circular business model



**Figure 1.** The Concept of Developing a Framework of Business Model for the Circular Economy.

## 2.1. Literature Review—Conceptual Frameworks for Categorizing the Research on Circular Business Models

This step identified the body of knowledge needed to obtain the answers for the research questions in the next steps. The following academic databases were used for the literature search: EBSCO Host, Google Scholar, Scopus, and ProQuest. Key words included variations on terms such as circular economy, business model, circular business model, sustainable business model. Then a complementary manual search was conducted on the websites of contributors to circular economy to look for other relevant papers, reports and books. Also the anonymous reviewers suggested some additional references.

This literature search generated articles on conceptualizing the state of the art on business models in the circular economy (circular business models) according to the eight sub-domains of research in the area of business models proposed by Pateli and Giaglis [15]. Those sub-domains include: definitions, components, taxonomies, conceptual models, design methods and tools, adoption factors, evaluation models, and change methodologies [15]. The research in the sub-domain of definitions concerns defining the purpose, scope, and primary elements of a business model, as well as exploring its relationships with other business concepts, such as strategy and business processes. Thus, in relation to circular business models, a wider context of the circular economy must be explained in the first place. Research on components of business models focuses on identifying its fundamental constructs and constituent elements. They are derived from the main principles of CE. Research in the taxonomies' sub-domain provides possible categorizations of circular business models into a number of typologies based on various criteria. Investigations related to the conceptual models focus on identifying and describing the relationship between the constituent elements of a circular business model, and include their graphical representation. Exploration of the design methods and tools concerns the development and use of methods, languages, standards and software to allow organizations to design, experiment, and change business models in an easy and cost-effective way into more circular business models. The research related to the adoption factors focuses on the factors that affect this change, as well as on socioeconomic implications of circular business models. The sub-domain related to evaluation models focuses on identifying criteria for assessing the feasibility, viability, and profitability of circular business models or evaluating them against alternative or best practice cases. Investigation concerning change methodologies pertain to guidelines, steps, and actions to be taken for transforming existing business models into a more circular one. Table 1 below presents an overview of this step, and the results are presented in the Section 2. This step identified the body of knowledge needed to obtain the answers for the research questions in the next steps.

**Table 1.** Categorization of the literature devoted to the circular economy.

CBM Research Domains	Authors
Definitions	EMF Vol. 1&2 [2,4]; Joustra <i>et al.</i> [16]; Mentink [11]; Scott [3]; Lovins <i>et al.</i> [17]; Renswoude <i>et al.</i> [7]; Linder & Williander [18]; Ayres & Simonis [19]; Renner [20]
Components	EMF Vol. 1. [4]; Renswoude <i>et al.</i> [7]; Boons and Lüdeke-Freund [21]; Laubscher and Marinelli [22]; EMF [23]; Mentink [11]; Govindan, Soleimani, & Kannan [24]
Taxonomies	Lacy <i>et al.</i> [25]; Bakker <i>et al.</i> [26]; Damen [27]; EMF Vol. 1. [4]; Lacy <i>et al.</i> [28]; WRAP [29]; Renswoude <i>et al.</i> [7]; Planing [5]; Jong <i>et al.</i> [14]; Tukker and Tischner [30]; Van Ostaeyen <i>et al.</i> [31]; El-Haggar [32]; Bakker <i>et al.</i> [33]; Lüdeke-Freund [12]; Moser and Jakl [34]; Mentink [11]; Scott [3]; Bautista-Lazo [35]; Tukker [36]; EMF [6]
Conceptual Models	Mentink [11]; Wirtz [9]; Osterwalder and Pigneur [8]; Barquet <i>et al.</i> [10]; Osterwalder <i>et al.</i> [37]; Lüdeke-Freund [12]; Dewulf [13]; Stubbs & Cocklin [38]; Roome and Louche [39]; Gauthier and Gilomen [40]; Abdelkafi and Tauscher [41]; Jabłoński [42]; Upward and Jones [43]; Nilsson & Söderberg [44]

Table 1. Cont.

CBM Research Domains	Authors
Design Methods and Tools	Joustra <i>et al.</i> [16]; Jong <i>et al.</i> [14]; Scott [3]; Renswoude <i>et al.</i> [7]; Osterwalder and Pigneur [8]; Mentink [11]; Barquet <i>et al.</i> [10]; Jabłoński [42]; Parlikad <i>et al.</i> [45]; El-Haggar [32]; Guinée [46]
Adoption Factors	Winter [47]; Planing [5]; Lacy <i>et al.</i> [28]; Joustra <i>et al.</i> [16]; Scott [3]; Parlikad <i>et al.</i> [45]; Mentink [11]; Laubscher and Marinelli [22]; EMF Vol. 1. [4]; Renswoude <i>et al.</i> [7]; Scheepens <i>et al.</i> [48]; EMF [6]; Jong <i>et al.</i> [14]; Beuren <i>et al.</i> [49]; Jabłoński [50]; Pearce [51]; Linder & Williander [18]; Parlikad, <i>et al.</i> [45]; Beuren <i>et al.</i> [49]; Jabłoński (2015); Zairul <i>et al.</i> [52]; Roos [53]; Bechtel <i>et al.</i> [54]; UNEP [55]; Besch [56]; Heese <i>et al.</i> [57]; Walsh [58]; Firnkorn & Muller [59]; Shafiee & Stec [60]
Evaluation Models	Winter [47]; Laubscher and Marinelli [22]; Mentink [11]; EMF [23]; Andersson & Stavileci [61]; Jasch [62]; Jasch [63]; Gale [64]
Change Methodologies	Scott [3]; Roome & Louche [39]; Gauthier & Gilomen [40]

## 2.2. Categorization of the Initial Body of Literature According to the Components of Business Model Structure

The second step identified how the idea of circular economy can be applied to each component of the business model. This approach was inspired by Barquet *et al.* [10], who used a similar one for the characteristics of product-service systems (PSS). Business model structure was defined on the basis of the business model canvas (BMC) developed by Osterwalder and Pigneur [8]. BMC was chosen due to the ease of its practical application, complexity of components, worldwide recognition, and previous contributions to the development of circular business models [10–12]. However, a relatively large proportion of the literature pointed out several ways of applying the principles of the circular economy which exceeded the existing components of the business model. Table 2 below presents an overview of this step, and the results are presented in Section 3.

**Table 2.** Example categorization of the literature devoted to the circular economy according to a business model structure.

BM components	Authors
Partners	Scott [3]; Joustra <i>et al.</i> [16]; El-Haggar [32]; Renswoude <i>et al.</i> [7]; Sheu [65]; Robinson <i>et al.</i> [66]; EMF Vol. 1. [4]
Key Activities	El-Haggar [32]; Scott [3]; WRAP [29]; Renswoude <i>et al.</i> [7]; Lacy <i>et al.</i> [28]; Rifkin [67]; Lacy <i>et al.</i> [25]; Joustra <i>et al.</i> [16]; EMF Vol. 3 [1]; Laubscher and Marinelli [22]; EMF Vol. 1. [4]; EMF [23]; EMF [6]
Key Resources	Planing [5]; Renswoude <i>et al.</i> [7]; Lacy <i>et al.</i> [28]; El-Haggar [32]; EMF [23]; Freyermuth [68]; Scott [3]
Value Proposition and Customer Segments	Jong <i>et al.</i> [14]; Planing [5]; Renswoude <i>et al.</i> [7]; Lacy <i>et al.</i> [28]; Parlikad <i>et al.</i> [45]; Bakker <i>et al.</i> [33]; El-Haggar [32]; Lacy <i>et al.</i> [25]; Scott [3]; EMF Vol. 1. [4]; Tukker and Tischner [30]; Tukker [36]; Laubscher and Marinelli [22]; Bakker <i>et al.</i> [26]; EMF [6]
Customer Relations	Renswoude <i>et al.</i> [7]; Recycling 2.0 [69]; Lacy <i>et al.</i> [25]
Channels	EMF [6]; Recycling 2.0 [69]; EMF [23]
Cost Structure	Laubscher and Marinelli [22]; Mentink [11]; Subramanian and Gunasekaran [70]; Sivertsson and Tell [71]; Berning and Venter [72]; Barquet <i>et al.</i> [10]
Revenue Streams	Van Ostaeyen <i>et al.</i> [31]; Renswoude <i>et al.</i> [7]; Tukker [36]
Additional Issues Related to Circular Economy	Material loops: EMF Vol. 1&2 [2,4]; Mentink [11]; Renswoude <i>et al.</i> [7]; Lacy <i>et al.</i> [28]; WRAP [29]; EMF Vol. 3 [1]; Govindan <i>et al.</i> [24]; El-Haggar [32]; EMF [23]; Freyermuth [68]; Scott [3]; Lacy <i>et al.</i> [25]; Planing [5];
	Adoption factors: Planing [5]; Scott [3]; El-Haggar [32]; Laubscher and Marinelli [22]; Lacy <i>et al.</i> [28]; Joustra <i>et al.</i> [16]; Jong <i>et al.</i> [14]; Renswoude <i>et al.</i> [7]; Barquet <i>et al.</i> [10]; Mentink [11]; Guinée [46]; EMF [23]; EMF [4]; EMF [6]; Parlikad <i>et al.</i> [45]; Stubbs & Cocklin [38]; Skelton and Pattis [73]; Winter [47]

### 2.3. Synthesis and Development of the Framework of Circular Business Model

Pursuing better answers to the research questions resulted in undertaking step 3. This step synthesizes how the circular economy principles apply to each component of the business model, and proposes the new components of the circular business model. These components pertain to the ways in which the CE principles exceeded the popular business model framework. Additionally, advantages and disadvantages of the new framework were outlined. These results are presented in the Section 4.

## 3. Research on Circular Business Models—The Review

### 3.1. Definitions

Although it is a contemporary movement, the circular economy is based on old ideas [74]; it is thus reasonable to outline its specificity. This includes the definitions, the origins of the movement, and its main principles. CE was probably first defined and conceptualized in the Ellen MacArthur Foundations report, as “an industrial system that is restorative or regenerative by intention and design” [4]. This means pursuing and creating the opportunities for a shift from an “end-of-life” concept to Cradle-to-Cradle™, from using unrenovable energy towards using renewable, from using toxic chemicals to their elimination, from much waste to eliminating waste through the superior design of materials, products, systems, and also business models [4]. The circular economy becomes a new vision of the treatment of resources, energy, value creation and entrepreneurship [16].

Linder and Williander [18] define a circular business model as “a business model in which the conceptual logic for value creation is based on utilizing the economic value retained in products after use in the production of new offerings” (p. 2). Mentink [11] defines CE as “an economic system with closed material loops,” and a circular business model as “the rationale of how an organization creates, delivers and captures value with and within closed material loops” (p. 35). He argues that circular business models do not necessarily aim to balance ecological, social and ecological needs, in contrast to business models, although at the same time they can serve sustainability goals [11]. However, another approach is also supported in the literature. Most recently, Scott [3] provided a useful conceptualization of CE in relation to sustainability. He argues for understanding the circular economy as “a concept used to describe a zero-waste industrial economy that profits from two types of material inputs: (1) biological materials are those that can be reintroduced back into the biosphere in a restorative manner without harm or waste (i.e.: they breakdown naturally); and, (2) technical materials, which can be continuously re-used without harm or waste” (p. 6). In turn, he defines sustainability as the capacity to continue into the long term and, at the same time, as a mechanism that enables the circular economy to work [3].

The general concept underlying the circular economy has been developed by many schools of thought, such as Regenerative Design, Performance Economy, Cradle to Cradle, Industrial Ecology, Biomimicry, Blue Economy, Permaculture, Natural Capitalism, Industrial Metabolism and Industrial Symbiosis [2,4,17,19,20]. Those schools of thought are complementary to each other and provided the foundation for the main principles of this new approach to economy [2,4,7,16]:

- (1) Design out waste/Design for reuse
- (2) Build resilience through diversity
- (3) Rely on energy from renewable sources
- (4) Think in systems
- (5) Waste is food/Think in cascades/Share values (symbiosis)

This variety of concepts supports Scott’s [3] approach to the relation between sustainability and circular economy.

### 3.2. Components

The fundamental constructs and constituent elements of circular business models can be derived from the main principles of the circular economy. In the literature, such components are understood and

defined variously, for instance: the ReSOLVE (regenerate, share, optimize, loop, virtualize, exchange) framework [4,23], ways of circular value creation [7], normative requirements for business models [21], and areas for integration [22].

There are six business actions to implement the principles of the circular economy and which represent major circular business opportunities depicted by the ReSOLVE framework [23]. Regenerate signifies the shift to renewable energy and materials. It is related to returning recovered biological resources to the biosphere. Thus it aims to reclaim, retain, and regenerate the health of ecosystems. Share actions aim at maximizing utilization of products by sharing them among users. It may be realized through peer-to-peer sharing of private products or public sharing of a pool of products. Sharing means also reusing products as long as they are technically acceptable to use (e.g., second-hand), and prolonging their life through maintenance, repair, and design-enhancing durability. Optimise actions are focused on increasing the performance/efficiency of a product and removing waste in the production process and in the supply chain. They may also be related to leveraging big data, automation, remote sensing, and steering. What is important is that optimization does not require changing the product or the technology. Loop actions aim at keeping components and materials in closed loops. The higher priority is given to inner loops. Virtualize actions assume to deliver particular utility virtually instead of materially. Exchange actions are focused on replacing old materials with advanced non-renewable materials and/or with applying new technologies (e.g., 3D printing). It may also be related to choosing new products and services [23].

Renswoude *et al.* [7] identify similar ways of circular value creation, pertaining to the short cycle, where products and services are maintained, repaired and adjusted, to the long cycle which extends the lifetime of existing products and processes, to cascades based on creating new combinations of resources and material components and purchasing upcycled waste streams, to pure circles in which resources and materials are 100% reused, to dematerialized services offered instead of physical products and to production on demand.

Other studies identified four normative requirements for business models for sustainable innovation, grounded in wider concepts such as sustainable development [21]. The first is a value proposition reflecting the balance of economic, ecological and social needs. The second is a supply chain engaging suppliers into sustainable supply chain management (materials cycles). The third is a customer interface, motivating customers to take responsibility for their consumption. The fourth is a financial model, mainly reflecting an appropriate distribution of economic costs and benefits among actors involved in the business model [21]. Boons and Lüdeke-Freund [21] (p. 13) also noticed that comparable conceptual notions of sustainable business models did not exist.

Mentink [11] (p. 34) used a similar approach to the business model as Frankenberger *et al.* [75], and outlined the changes of business model components needed for developing a more circular service model, such as:

- value propositions (*what?*)—products should become fully reused or recycled, which requires reverse logistics systems, or firms should turn towards product-service system (PSS) and sell performance related to serviced products
- activities, processes, resources and capabilities (*how?*)—products have to be made in specific processes, with recycled materials and specific resources, which may require not only specific capabilities but also creating reverse logistics systems and maintaining relationships with other companies and customers to assure closing of material loops
- revenue models (*why?*)—selling product-based services charged according to their use
- customers or customer interfaces (*who?*)—selling “circular” products or services may require prior changes of customer habits or, if this is not possible, even changes of customers

Laubscher and Marinelli [22] identified six key areas for integration of the circular economy principles with the business model:



- (1) Sales model—a shift from selling volumes of products towards selling services and retrieving products after first life from customers
- (2) Product design/material composition—the change concerns the way products are designed and engineered to maximize high quality reuse of product, its components and materials
- (3) IT/data management—in order to enable resource optimization a key competence is required, which is the ability to keep track of products, components and material data
- (4) Supply loops—turning towards the maximization of the recovery of own assets where profitable and to maximization of the use of recycled materials/used components in order to gain additional value from product, component and material flows
- (5) Strategic sourcing for own operations—building trusted partnerships and long-term relationships with suppliers and customers, including co-creation
- (6) HR/incentives—a shift needs adequate culture adaptation and development of capabilities, enhanced by training programs and rewards

One of the most important components of circular business models is the reversed supply-chain logistics. A comprehensive review on this subject has been done by Govindan, Soleimani, and Kannan [24].

### 3.3. Taxonomies

In the literature, there are several propositions of how to categorize business models. Most of them are very similar and use the criterion of the source of value creation (e.g., [4,7,25]). Few authors proposed other criteria, such as sources of value in a product-service systems [5,14,30], before-the-event techniques of cleaner production [32], design strategies for product life extension [33], cycle of product/component/material circulation in material loops [5], or mixed criteria [12]. However, the typologies are somewhat overlapping, and the distinction criteria are sometimes blurred. An overview of the circular business models, systematized according to the ReSOLVE framework, is presented in Table 3.

**Table 3.** An overview of circular business model types.

Classification Criteria	Model	Literature Sources	Explanation	Example(s)
Regenerate	Energy recovery	Damen [27]; Lacy <i>et al.</i> [28]	The conversion of non-recyclable waste materials into useable heat, electricity, or fuel	Ralphs and Food 4 Less installed an “anaerobic digestion” system
	Circular Supplies	Lacy <i>et al.</i> [28]; EMF [23]	Using renewable energy	Iberdrola
	Efficient buildings	Scott [3]	Locating business activities in efficient buildings	Phillips Eco-Enterprise Center
	Sustainable product locations	Scott [3]	Locating business in eco-industrial parks	Kalundborg Eco-industrial Park
	Chemical leasing	Moser and Jakl [34]	The producer mainly sells the functions performed by the chemical, so the environmental impacts and use of hazardous chemical are reduced	Safechem
Share	Maintenance and Repair	Lacy <i>et al.</i> [28]; WRAP [76]; Bakker <i>et al.</i> [33]; Planing [5]; Damen [27]	Product life cycle is extended through maintenance and repair	Patagonia, Giroflex
	Collaborative Consumption, Sharing Platforms, PSS: Product renting, sharing or pooling	Lacy <i>et al.</i> [28]; Lacy <i>et al.</i> [25]; WRAP [76]; Planing [5]; Tukker [36]; Jong <i>et al.</i> [14]	Enable sharing use, access, or ownership of product between members of the public or between businesses.	BlaBlaCar, Airbnb, ThredUP,
	PSS: Product lease	Tukker [36]; Jong <i>et al.</i> [14]; WRAP [76];	Exclusive use of a product without being the owner	Mud Jeans, Dell, Leasedrive, Stone Rent-a-PC
	PSS: Availability based	Van Ostaeyen, <i>et al.</i> [31]; Mentink [11]	The product or service is available for the customer for a specific period of time	GreenWheels
	PSS: Performance based	Van Ostaeyen, <i>et al.</i> [31]; Zairul <i>et al.</i> 2015 [52]	The revenue is generated according to delivered solution, effect or demand-fulfilment	Philips’s “Pay per Lux” solution; the need for new housing model for young starters in Malaysia
	Incentivized return and reuse or Next Life Sales	WRAP [76]; Mentink [11]; Lacy <i>et al.</i> [25]; Damen [27]	Customers return used products for an agreed value. Collected products are resold or refurbished and sold	Vodafone Red Hot, Tata Motors Assured
	Upgrading	Planing [5]; Mentink [11]	Replacing modules or components with better quality ones	Phoneblocks
	Product Attachment and Trust	Mentink [11]	Creating products that will be loved, liked or trusted longer	Apple products
	Bring your own device	WRAP [76]	Users bring their own devices to get the access to services,	Citrix pays employees for bringing own computers
	Hybrid model	Bakker <i>et al.</i> [26]	A durable product contains short-lived consumables	Océ-Canon printers and copiers
	Gap-exploiter model	Bakker <i>et al.</i> [26]; Mentink [11]	Exploits “lifetime value gaps” or leftover value in product systems. (e.g., shoes lasting longer than their soles).	printer cartridges outlasting the ink they contain



Table 3. Cont.

Classification Criteria	Model	Literature Sources	Explanation	Example(s)
Optimise	Asset management	WRAP [76]	Internal collection, reuse, refurbishing and resale of used products	FLOOW2, P2PLocal
	Produce on demand	Renswoude <i>et al.</i> [7]; WRAP [76], Scott [3]	Producing when demand is present and products were ordered	Alt-Berg Bootmakers, Made, Dell Computer Company
	Waste reduction, Good housekeeping, Lean thinking, Fit thinking	Renswoude <i>et al.</i> [7]; Scott [3]; El-Haggar [32]; Bautista-Lazo [35]	Waste reduction in the production process and before	Nitech rechargeable batteries
	PSS: Activity management/outsourcing	Tukker [36]	More efficient use of capital goods, materials, human resources through outsourcing	Outsourcing
Loop	Remanufacture, Product Transformation	Damen [27]; Planing [5]; Lacy <i>et al.</i> [25]	Restoring a product or its components to “as new” quality	Bosch remanufactured car parts
	Recycling, Recycling 2.0, Resource Recovery	Lacy <i>et al.</i> [25] Damen [27] Planing [5]; Lacy <i>et al.</i> [28]	Recovering resources out of disposed products or by-products	PET bottles, Desso
	Upcycling	Lacy <i>et al.</i> [28] Mentink [11]; Planing [5]	Materials are reused and their value is upgraded	De Steigeraar (design and build of furniture from scrap wood)
	Circular Supplies	Renswoude <i>et al.</i> [7]; Lacy <i>et al.</i> [28]	Using supplies from material loops, bio based- or fully recyclable	Royal DSM
Virtualize	Dematerialized services	WRAP [76]; Renswoude <i>et al.</i> [7]	Shifting physical products, services or processes to virtual	Spotify (music online)
Exchange	New technology	EMF [6]	New technology of production	WinSun 3D printing houses

### 3.4. Conceptual Models

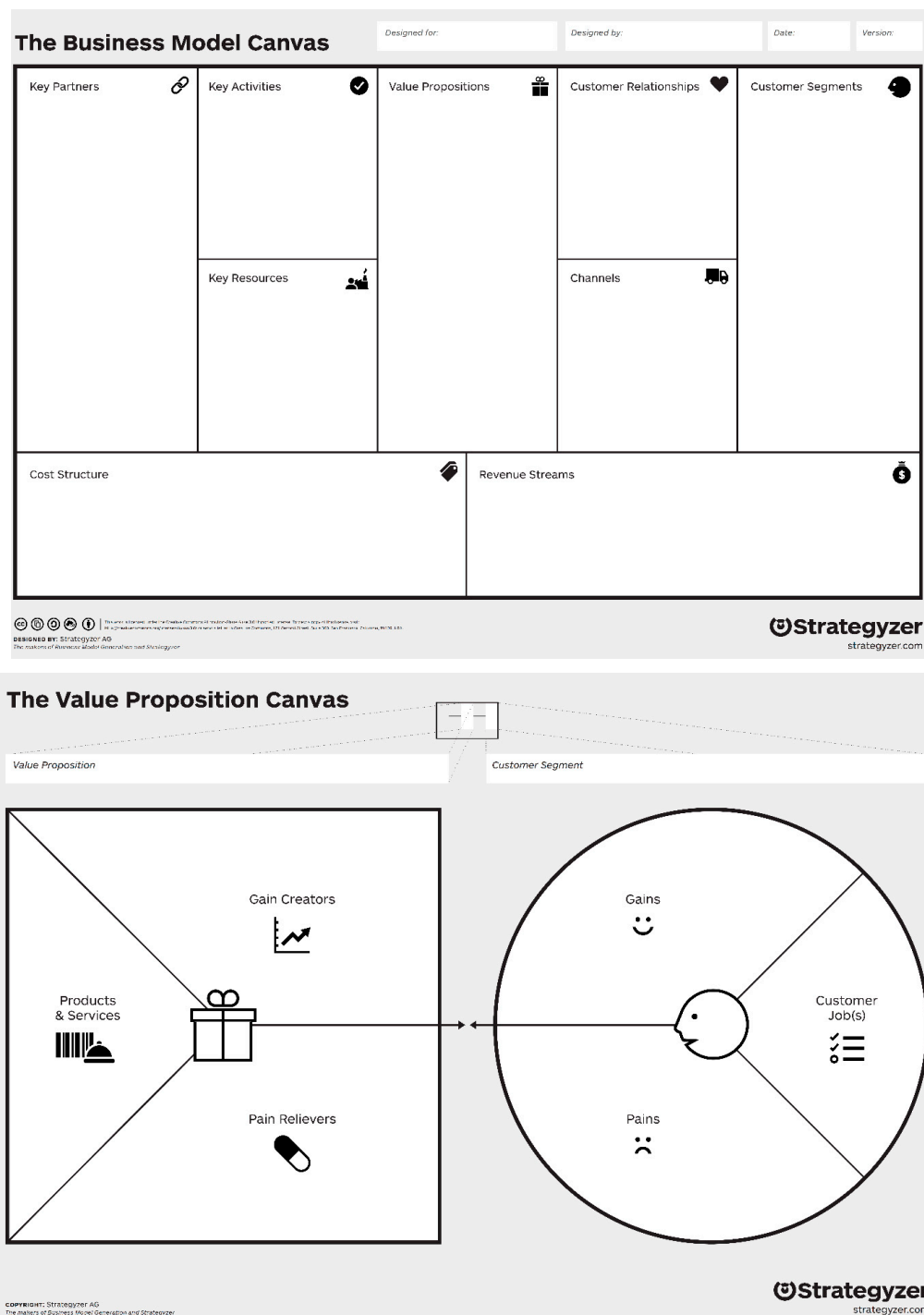
The relationships between constituent elements of a circular business model have been conceptualized in the literature. Every business model is both linear and circular to some extent [7,11]. This is because every company optimizes its processes, virtualizes products or processes (using e-mails instead of traditional letters) and/or uses some resources from material loops, and thus introduces some principles of the circular economy, albeit not necessarily deliberately. Renswoude *et al.* [7] put it differently—“100% circular business models do not exist (yet). Not creating any waste at all is difficult to achieve for physical and practical reasons (p. 2)”. For this reason, the main conceptual frameworks of business models apply to the circular economy. However, some frameworks of circular business models have been developed for either type.

There are quite many conceptual frameworks of business models in general [75,77–82]. Thus, a further systematization became a reasonable direction of research. And so, there are two more comprehensive propositions, one by Wirtz [9], and one by Osterwalder and Pigneur [8]. Wirtz (2011) [9] made a systematic overview of the business model concept, and proposed an integrated business model consisting of nine partial models divided into three main components—strategic, customer and market, value creation. The strategic component comprises three models regarding the strategy (mission, strategic positions and development paths, value proposition), resources (core competencies and assets), and network (business model networks and partners). The customer and market components consist of customer model (customer relationships/target group, channel configuration, customer touchpoint), market offer model (competitors, market structure, value offering/products and services), and revenue model (revenue streams and revenue differentiation). The value creation component encompasses production of goods and services (manufacturing model and value generation), procurement model (resource acquisition and information), and financial model (financing model, capital model and cost structure model).

A more recognized and applied framework of a business model distinguishes nine building blocks [83], and is conceptualized as the business model canvas (BMC) [8]. The BMC consists of [8,10]:

- (1) Customer segments that an organization serves
- (2) Value propositions that seek to solve customers' problems and satisfy their needs
- (3) Channels which an organization uses to deliver, communicate and sell value propositions
- (4) Customer relationships which an organization builds and maintains with each customer segment
- (5) Revenue streams resulting from value propositions successfully offered to customers
- (6) Key resources as the assets required to offer and deliver the aforementioned elements
- (7) Key activities which are performed to offered and deliver the aforementioned elements
- (8) Key partnerships being a network of suppliers and partners that support the business model execution by providing some resources and performing some activities
- (9) Cost structure comprising all the costs incurred when operating a business model

Most recently, value proposition design has been developed, and comprises of six building blocks, which are a detailed description of the two BM canvas blocks—value propositions and customer segments [37]. Value proposition is composed of the products and services offered to the customer, the relievers of customers pains, and the creators of customer gains pertaining to the tasks and jobs he or she needs to accomplish with the assistance of the offered product or service. Thus, on the customer's side are the jobs, pains and gains related to doing the jobs. The visualization of both canvases are presented in Figure 2.



**Figure 2.** The Business Model Canvas and the Value Proposition Canvas. Source: Osterwalder and Pigneur [8] and Osterwalder *et al.*, (2014) [37]. Reproduced with permission from Strategyzer.com and Strategyzer AG.

The BM canvas has been recognized and used for further conceptualizations of circular and sustainable business models, such as Barquet *et al.* [10], Lüdeke-Freund [12], Dewulf [13], Mentink [11], and Nilsson and Söderberg [44]. Barquet *et al.* [10] used the BM canvas for identification and classification of the product service systems' characteristics according to a business model structure. Moreover, the authors used it as design tool for a circular business model [10]. Lüdeke-Freund [12] applied the business model canvas (BMC) developed by Osterwalder and Pigneur [8] to the context

of eco-innovation. In Lüdeke-Freund's framework, the canvas is a central component, but linked with others, both preceding and subsequent. The infrastructure management (partners, resources, activities) is highly impacted by the development of marketable eco-innovations, barriers of sustainable development, and marketing eco-innovations. Thus, contextual factors are important enablers for a business model to operate in practice. On the other hand, eco-innovations create an extended customer value (a mix of customer public value, customer equity and customer value). Dewulf [13] developed an extended business model canvas with two additional components—societal costs and societal benefits. Mentink [11] developed a business cycle canvas, which applies the concept of business cycle to the business model framework. This proposition is focused on the circulation of materials in a closed loops, and thus is more useful to analyze if the company's network will support material loops. Nilsson and Söderberg [44] developed a business model canvas adjusted for the urban mining segment and evaluated the business model element differences between the traditional C and D and urban mining industry.

Some other conceptual frameworks exist in the literature related to sustainability. For instance, Stubbs and Cocklin [38] developed a case study-based conceptualization of a sustainability business model, consisting of two types of attributes—structural and cultural ones. Each type has its economic, environmental, social, and holistic characteristics. Structural attributes are depicted by:

- Economic characteristics, such as external bodies expecting triple bottom line performance, lobbying for changes to taxation system and legislation to support sustainability, keeping capital local
- Environmental characteristics, such as a threefold strategy (offsets, sustainable, restorative), closed-loop systems, implementation of services model, operating in industrial ecosystems and stakeholder networks
- Social characteristics, such as understanding stakeholder's needs and expectations, educating and consulting stakeholders

Holistic characteristics, such as cooperation and collaboration; triple bottom line approach to performance; implementing demand-driven model; adapting organization to sustainability.

Cultural attributes are depicted by:

- Economic characteristics, such as considering profit as a means to do something more ("higher purpose"), not as an end, which is also a reason for shareholders to invest
- Environmental characteristics, such as treating nature as a stakeholder
- Social characteristics, such as balancing stakeholders' expectations, sharing resources among stakeholders, and building relationships
- Holistic characteristics, such as focusing on medium to long-term effects, and on reducing consumption

Most recent contributions to conceptual models concern the dynamics between components of the business model. For instance, Roome and Louche [39] developed *process model of business model change for sustainability*, which explains how new business models for sustainability are fashioned through the interactions between individuals and groups inside and outside companies. Gauthier and Gilomen [40] analyzed transformations of the elements of sustainable business model and identified a typology of such changes (see Subsection 3.8 in this paper). Abdelkafi and Täuscher [41] developed a system dynamics-based representation of business models for sustainability. Not only has the dynamic of internal business model components been researched, but also the dynamics in relation to the business model environment. One of the key issues in this regard pertains to networks. Jabłoński [42] outlined the process of transition from an idea to the operationalization of the business model by searching for business model components from the network. However, the static approach is also being investigated. For example, Upward and Jones [43] developed the strongly sustainable business model ontology. Another approach proposed by Bautista-Lazo and Short [84] conceptualized an All

Seeing Eye of Business model, which addresses the types of waste and their potential as a profit or loss generator.

### 3.5. Design Methods and Tools

There are several design methods and tools for the business model in the literature. Some of them focus on enhancing the design process [3,7,8,10], and others are used in particular situations and for particular business models [32,42,46].

Joustra *et al.* [16] and Jong *et al.* [14] identified five steps to support for small and medium enterprises (SMEs) to enter the circular economy. The first two steps comprise reading about the CE, and learning about the readiness of the company, partners and stakeholders in the supply chain for CE. The next two steps suggest evaluating redesign opportunities that might bring the products into a more circular business model, and to understand the service that a company could potentially deliver and how the model needs to be redesigned to enable this. The last step tests whether the value delivered is the value that customers expect and will pay for.

Scott [3] proposed the 7-P model as a starting point toward understanding and applying the mechanism of the circular economy in a business. This model takes the practitioner's approach and describes seven main components, which can be divided into three steps. The first is to learn and understand the fundamentals of the circular economy, and what the change will concern, and decide on establishing sustainability as an objective (prepare). The next step is to organize and implement the mechanisms of the circular economy related to the process, preservation, people, place, product, and production. The last step is to enable and support implementation of CE, mainly through building teams and managing change (People).

Renswoude *et al.* [7] developed the business model scan, a methodology to enhance a transition of the company into a more circular form. It consists of six process stages about which many questions are asked. Those questions are related to value proposition, design, supply, manufacturing, use, and next life. Osterwalder and Pigneur [8] proposed five stages of business model design process, encompassing mobilize, understand, design, implement, and manage. This methodology is supported by the business model canvas (described in Section 3.4). BMC has been applied to research and design circular business models [10,11]. Jablonski [42] distinguished eleven stages of the design and operationalization of the company's technological business model embedded in the network. Parlikad *et al.* [45] identified the information requirements for end-of-life decision making and established a possible set of characteristics of a lifecycle information system to support management. They also reviewed existing product lifecycle information systems and divided them into two categories. Design/disassembly data-sharing systems encompass: Inverse Manufacturing Product Recycling Information System (IMPRIS), Recycling Passport, Products Lifecycle Management System (PLMS), Integrated Recycling Data Management System (ReDaMa). Lifecycle information monitoring systems comprises of: Information System for Product Recovery (ISPR), Life Cycle Data Acquisition System (LCDA), Green Port [45]. Cleaner production audits are undertaken to identify opportunities for cleaner production. The methodology for the cleaner production opportunity assessment has been outlined by El-Haggar [32] (p. 29), and consists of many activities related to and focused on the following: team, pre-audit, surrounding environment, operations and processes, inputs and outputs, wasteful processes, material and energy balance, opportunities, priorities, implementation, assessment, process sustainability, sustainable development. Another important method is life cycle assessment [85] which is explained as “a tool for the analysis of the environmental burden of products at all stages in their life cycle—from the extraction of resources, through the production of materials, product parts and the product itself, and the use of the product to the management after it is discarded, either by reuse, recycling or final disposal (in effect, therefore, ‘from the cradle to the grave’)” [46] (pp. 5–6). Scott [3] (p. 81) also suggests that environmental audits, such as compliance audit, waste audit, waste disposal audit, water audit, can be used. Mentink [11] discussed a few other methods and tools, such as: New Framework on

Circular Design, Practical Guide for PSS Development, Circular Economy Toolkit, Play it Forward, 4-I Framework, and Sustainable Business Model Canvas.

### 3.6. Adoption Factors

Factors affecting CBM adoption are mostly related to general factors [5,47], human resources [3,16,28], political system and legislation [3,6], IT and data management [3,45], and business risks [11]. There are also crucial socioeconomic implications, justifying the efforts towards CE [4,7,22], and other enablers such as leadership, collaboration, motivation through the concept itself, and customer behavior [53].

General factors encompass conditions which need to be fulfilled to secure profitability of closed circles. Winter [47] (p. 16) points out five of them: sufficiently valuable materials/products, control of product or material chain, ease of reuse, remanufacture or recycle materials/products, predictable demand for future products, keeping materials/products concentrated and uncontaminated. Planing [5], however, argued that customer irrationality, conflict of interest within companies, misaligned profit-share along the supply chain, and geographic dispersion could be the reasons for rejecting circular business models. Scheepens *et al.* [48] argue that transition to CE is impacted by different factors on several levels: societal, regulatory, services and infrastructure, and product and technology. Sivertsson and Tell [71] identified barriers to business model innovation in the agricultural context for each of the nine building blocks of the business model canvas (by Osterwalder and Pigneur [8]). Pearce identified six kinds of customers whose needs may be satisfied by the companies offering remanufactured products. These types comprise the customers who (1) need to retain a specific product because it has a technically defined role in their current processes; (2) want to avoid the need to re-specify, re-approve or re-certify a product; (3) make low utilization of new equipment; (4) wish to continue using a product which has been discontinued by the original manufacturer; (5) want to extend the service lives of used products, whether discontinued or not; and (6) are interested in environmentally friendly products [51]. Linder and Williander [18] outlined challenges regarding remanufacturing, such as: considerable expertise and knowledge of the product; efficient product retrieval; suitable types of products; risk of cannibalization if the new, longer-lasting products reduce sales of the previous products; fashion changes; a financial risk for the producer if the offer is to be rented; increased operational risk; lack of supporting law, policy and regulations; and compatibility with the business models of partners.

Regarding the role of human resources in a company shift towards the circular economy, various suggestions have been made. On the basis of successful waste elimination schemes, Scott [3] formulated general recommendations for creating teams related to team members and team size, volunteers, goals, motivation, maintaining links with organization, organizing team meetings, positive thinking, and leadership. Lacy *et al.* [28] (p. 18) identified five capabilities of successful circular leaders (business planning and strategy, innovation and product development, in sourcing and manufacturing, sales and marketing, reverse logistics and return chains). Other researchers also emphasized the role of leadership, mostly pertaining to the appreciation of the new strategic direction, understanding its benefits and risks, and the ability to establish a common understanding in the business [53,54].

Joustra *et al.* [16] (p. 11) identified eight elementary skills for any circular economy project team, such as: entrepreneurial and developing, craftsmanship aimed at product/services, systems thinking and capability of identifying causal loops, future oriented and out-of-the-box, celebrating diversity, addressing insecurities, designing circular systems, products and services, and being creative, innovative and connected. Laubscher and Marinelli [22] give some insights from the practice and emphasized the role of adequate culture adaptation and development of capabilities in a BM transformation towards CE. This can be obtained through dedicated training programs, performance and rewards schemes, personal targets and bonuses for sales managers.

Others argue that policymakers at all government levels (municipal, regional, national, and supranational) play an important role in the circular economy [3,6]. There are two broad and



complementary policymaking strategies to accelerate the circular economy: fixing market and regulatory failures, and stimulating market activity by, for example, setting targets, changing public procurement policy, creating collaboration platforms and providing financial or technical support to businesses [6].

Parlikad, *et al.* [45] and Scott [3] (p. 79) argue that IT and data management systems are essential for the circular economy, because they allow to keep track of products, components and material data. This strongly supports effective reverse logistics systems, material loops (also cross-industry) and reuse of components.

Some business risks of service models (or PSS) have also been identified in the literature. They are related to the fact that (a) owning a product is preferred if the user is emotionally attached to the product or the product has an important intangible value, impacting, for instance, the owner's social status; (b) result or function-oriented services need a good explanation and description, which may increase transaction costs; (c) the service provider must predict and control the risks, uncertainties and responsibilities related to selling a result-oriented service [11,14,16]. Moreover, validating a circular business model always has a higher business risk than validating a corresponding traditional, linear business model [18].

Regarding the impact of the circular economy, there are three main winners: economies, companies and user/consumers [3,4,7,55]. CE advantages for economies are related to e.g., the impact on economic growth, material cost savings, mitigation of price volatility and supply risks, significant job growth in services, employment market resilience [4,49]. Laubscher and Marinelli [22] point that companies can gain financial and reputational value. Others argue that CE will give the companies new profit possibilities, increase competitive advantage and build resilience against several strategic challenges [4,56,57]. Detailed advantages could concern: innovation and competitive advantage, additional revenue streams, long-term contracts, customer loyalty and feedback, multiple benefits of internal resource management, and beneficial partnerships throughout the value chain [7,58–60]. Customer and user benefits mainly comprise of increased choice at lower cost; however, there are also some social benefits, like a contribution against climate change [4,52].

Importantly, adaptation factors change in time and those changes also impact the evolution of business models [50].

### 3.7. Evaluation Models

The criteria for assessing the feasibility, viability, and profitability of circular business models must be adjusted to the micro, meso and macro-level of implementation [47]. On the micro-level Laubscher and Marinelli [22] argue for measuring the reduced ecological footprint, direct financial value through recovery of materials and assets, and top line growth through new business models. A more extended set of key performance indicators could encompass a percentage of: revenues from repairs, reused parts, refurbished products, recycled material used product value after period X, revenue from second-hand products, times of reuse of resource, technical lifetime value of by-products, by-products used, separability of resources, toxic materials used, and products leased [11]. Anderson and Stavileci [61] proposed several criteria for evaluation of the business model's validity for the circular economy, such as: turnover possibility, margins, capital intensiveness, implementation time, dependence on supplier, possible usage of recycled materials, usage of unsustainable materials, benefits from additive manufacturing, percentage of lifecycle, product oriented, and service oriented. There are also some guidelines for accounting the costs of material flow (MFCA) [62–64].

On the macro-level, there are several measurements for three CE principles [23]. Measurements concerning the principles of preservation and enhancing natural capital by controlling finite stocks and balancing renewable resource flow, comprise degradation-adjusted net value add (NVA) as a primary metric, and annual monetary benefit of ecosystem services, annual degradation, and overall remaining stock as secondary metrics. Measurements for the principle of optimization of resource yields by circulating products, components and materials in use at the highest utility at all times in

both technical and biological cycles, encompass as a primary metric GDP-generated per unit of net virgin finite material input, and product utilization, product depreciation/lifetime, and material value retention or value of virgin materials as secondary metrics. Measurements for the principle of fostering system effectiveness by revealing and designing out negative externalities, consist of cost of land, air, water, and noise pollution, as a primary metric, and toxic substances in food systems, climate change, congestion, and health impacts as secondary metrics [23].

### 3.8. Change Methodologies

Scott [3] (pp. 103–109) argues that basic change management theories, like the Force Field Theory, Three-Stage Approach to Change Behavior, sources of staff resistance to change, can be successfully applied to manage the transition from a linear business model towards a circular one. However, other studies provide theories more specific to CE. For example, the model of the process of changing business model for sustainability explains how new business models for sustainability are fashioned through the interactions between individuals and groups inside and outside companies [39]. Gauthier and Gilomen [40] identified a typology of business model transformations toward sustainability:

- (1) Business model as usual—if there are no transformations to business model elements
- (2) Business model adjustment—if marginal modifications to one element of BMs occur
- (3) Business model innovation—if major BM transformations were implemented
- (4) Business model redesign—if a complete rethinking of organizations' BM elements results in radically new value propositions

## 4. Circular Economy and the Components of Business Model

### 4.1. Value Propositions Fitting Customer Segments (Value Proposition Design)

The core component of the circular business model is the value proposition. Circular value proposition offers a product, product-related service or a pure service [14]. This offer must allow the user/consumer to do what is needed, reduce inconveniences which the consumer/user would experience, and provide additional benefits [37].

Circular products, although ownership-based [5], have several specific features related to the CE principles. Circular products enable product-life extension through maintenance, repair, refurbishment, redistribution, upgrading and reselling [5,7,28,33,45]. They are designed to enhance reusing, recycling, and cascading. This requires a modular design and choosing materials that allow cascading, reusing, remanufacturing, recycling, or safe disposal. Thus, such products are 100% ready to circulate in the closed material loops. Moreover, product design should allow using less raw material or energy or to minimize emissions [3,25,32]. Circular products can be also dematerialized and offered not as physical but as virtual products [4,7].

In a product-service system a company offers access to the product but retains its ownership. It is an alternative to the traditional model of “buy and own”. This is a way of reducing customer pains, creating gains, and getting the jobs done through offering product-oriented services or advice, use-oriented services including product leasing, renting, pooling, and pay-per-service unit, or result-oriented services, comprising outsourcing and functional result [14,25,28,30,36]. Some examples comprise: Philips pay-per light [22] or GreenWheels' shared car use, hours of thrust in a Rolls-Royce, or “Power-by-the-Hour” jet engines [26].

Circular value propositions related to services may concern shifting their traditional form to a virtual one (e.g., virtual travel) [4,6,7].

Collaborative consumption related to product sharing/renting or product pooling can bring cost savings, services tailored for customer needs, and additional benefits. For instance, BlaBlaCar offers not only cheap transportation possibilities and route connections unavailable by public transport, but also social gains (see blablacar.com). Some other sharing-based value propositions concern sharing

residence, parking, appliances/tools sharing, office, and flexible seating, which may require some specially developed platforms [4,7,28].

Usually there are some incentives offered to the users/consumers [76]: for example, buy-back programs like Vodafone—New Every Year/Red Hot [1]. In this case, incentives are a source of value for the customer (part of value proposition), and products, components or materials collected back contain a value retrieved by the company.

The value proposition must be appropriate for particular customer segments, for specific types of customers [51].

#### 4.2. Channels

One of the strongest shifts towards a circular business model regarding channels is virtualization. This means that an organization can sell a virtualized value proposition and deliver it virtually (selling digital products, like music in mp3 format) and/or sell value propositions via virtual channels (online shops selling material products) [6]. Another possibility is to communicate virtually with the customer (e.g., using web advertisements, e-mails, websites, social media, video conferences) [23,69].

#### 4.3. Customer Relationships

Building and maintaining relationships with customers can underlie the main principle of the circular economy—eliminating waste—twofold. Those two options encompass producing on order, and engaging customers to vote for which product to make [7]. Additionally, a switch to recycling 2.0 may enhance social-marketing strategies and leverage relationships with community partners [25,69].

#### 4.4. Revenue Streams

Revenue streams are essentially the ways in which a company makes money. There are several circular propositions, mainly associated with the product-service systems [7,31]. The first is an input-based PSS, like pay per product or pay per service. The second is availability-based PSS, encompassing a subscription-based rental where, against a low, periodic fee, consumers can use a product or service; or a progressive purchase, where customers periodically pay small amounts before the purchase. The third is usage-based PSS like pay per use, which is a one-time payment to use a product or service. The fourth one is performance-based, like performance-based contracting. However, several performance-based PSSes are possible, like solution-oriented (e.g., selling a promised level of heat transfer efficiency instead of selling radiators), effect-oriented (e.g., selling a promised temperature level in a building instead of selling radiators), and demand-fulfilment oriented (e.g., selling a promised level of thermal comfort for building occupants instead of selling radiators) [31]. Two traditional options of revenue streams concern selling pure products or pure services [36]. Revenue streams depend on the value proposition.

Moreover, revenue streams may be related to retrieved value, generated from products, components and/or raw materials collected back. For example product components, when collected back, are resold after they were restored to “as-new” quality, or remanufactured, or used to create a new product if they carry a high value [5,25]. Despite how low or high the value, it must be sufficient to make the material loops economically reasonable. Retrieved value may also be related to energy captured from waste disposal [4].

#### 4.5. Key Resources

The assets required to create, offer and deliver value propositions via chosen channels, to build and maintain relationships and to receive revenue flows, correspond with the principles guiding the circular economy in two major ways. One is focused on input choices and the second on regenerating and restoring the natural capital.

The input choices are related to changing input materials and products. This can be done through so-called circular sourcing, which applies the principle of using only products or materials obtained

from closed material loops along four circular flows [5,7,28]. Another way to achieve this is direct substitution of resources with better-performing materials, which are “less harmful to the environment, more feasible to use and have the same or better technical requirements” [32] (p. 27). Next option is direct virtualization of materials, as for instance through digitalization [23,68].

Natural capital regeneration and restoring concerns using energy from renewable sources, land restoration or reclamation, saving water, operating in more efficient buildings, and choosing sustainable production locations like eco-parks [3].

#### 4.6. Key Activities

The key activities which directly or indirectly lead to creating, offering and delivering the value propositions, may apply the CE principles in several ways. Some are oriented on increasing performance, product design, technology exchange, and the other on remanufacturing, recycling or even lobbying.

Increasing performance can be obtained through good housekeeping, better process control, equipment modification and technology changes, sharing and virtualization. Good housekeeping and process control involve not only optimization of the process by elimination of any fault that would result in unnecessary losses, like spills, leakage, overheating *etc.*, but also effective and efficient planning and regulating of the process to ensure optimal conditions such as temperature, pH, pressure, water level, time, *etc.* [32]. This requires, for instance, continuous monitoring and management, a regular preventive maintenance program, raising staff environmental awareness, and incentive mechanisms, and is supported by lean thinking and lean management [3,32]. Recently, another way of increasing performance has been introduced—the “bring your own device” model [76]. It assumes that users bring their own devices in order to get the access to services, and thus the quantity of products required to meet market need is being reduced. An example is Citrix where employees are paid for bringing their own computers into the company to use on the company’s network for work and home [76]. Equipment modification and technology changes improve the production process or replace one with another, and in turn increase efficient utilization of raw materials, water, energy, reduce emissions and eliminate toxic materials from production [32]. A good example is using 3D printing to produce what is needed [7]. Increasing performance may be related also with sharing and virtualizing office space through flexible seating, desk-sharing, office hoteling, tele-working, audio and video conferences, the “internet of things”, big data and machine learning [23,28,67].

Appropriate product design enables using less raw material or energy, to reduce emissions and toxic materials, prolonging product life, eliminating waste before resource-life extension, and to circulate the product, components and materials in a 100% closed material loop, according to the Cradle-to-Cradle concept [1,3,16,25,32].

Moreover, sometimes lobbying for the changes of legislation and political incentives to accelerate the circular economy is necessary [3,4,6,7,22]. When a company is directly engaged in lobbying, then it becomes the key activity. Otherwise lobbying depends on third-party entities and is considered as an adaptation factor.

#### 4.7. Key Partnerships

Cooperative networks allow businesses to receive advantages from supplies, and support a company in research, product design, marketing, office support, supply routes, financial functions, production processes, and management [3,16]. Thus, collaboration enhances obtaining key resources and performing key activities. For instance, off-site recycling is done by other parties that recycle the industrial wastes at the post-consumer stage or recycle the specific wastes, which then are sold to other industries [32]. Collaborative production, based on the cooperation in the production value chain, allows the materials to circulate in a so-called closed material loop [7]. Sheu [65] argues that collaborative relationships play an important role in the green supply chains. Robinson *et al.* [66] showed that business models for solar-powered charging stations to develop infrastructure for electric

vehicles may need a strong engagement of public organizations as collaborating partners. Considering the value chain and supply chain, the more circular partners in those chains, the more circular the economy. The “butterfly diagram” developed by the Ellen MacArthur Foundation shows the key role of manufactures and recycling companies [4]. Without collaboration, achieving circularity is hardly possible [53,54]. However, regarding cooperation types, different strategies support different business models [86].

#### 4.8. Cost Structure

The reviewed literature provided no good examples on how the cost structure can enhance implementation of CE principles. However, whenever a company decides to change the cost structure it might require further organizational changes, such as for materials, energy consumption, staff behavior *etc.*, and in turn elicit more circular changes to the business model. This process could start with the analysis of the cost structure. In this regard, cost structure-related criteria can help to evaluate efficiency of optimization policies [11,22]. Cost structure is usually mentioned when the implications and potential benefits of CE are described. It may pertain to cost savings related to PSS or reverse material flow [62–64,70], production costs in agriculture [71], costs of product development [72], or investments [10].

#### 4.9. The Need for Additional Components of a Business Model Related to the Circular Economy

The literature review conducted allowed the identification of how the principles of the circular economy can be applied to the nine components of the business model [8]. An overview according to the ReSOLVE framework is presented in Table 4.

**Table 4.** How the circular economy principles apply to the components of business model.

BM Components	Regenerate	Share	Optimize	Loop	Virtualize	Exchange
Partners		X		X		
Activities	X		X	X	X	
Resources	X		X	X	X	
Value proposition and Customer segments		X		X	X	
Customer relations						
Channels					X	
Cost structure	X		X	X		X
Revenue streams		X		X		
<b>Potential to develop the BM framework</b>						
Take-back system				X		
Adoption factors	X	X	X	X	X	X

Note: X indicates that the circular economy principles apply to the particular component of business model.

It supports the conclusion that especially two areas related to CE should be introduced to the business model framework in order to enhance designing more circular business models. These are the take-back system [4,7,24,28] and the adoption factors [5].

## 5. Conceptualizing the Framework of the Circular Business Model Canvas

### 5.1. Key Areas of Redesigning a Business Model Framework

The conducted study revealed two additional components of the business model framework in order to develop a circular business model framework. This section continues to build on the concept of the business model canvas [8], and describes the novelties and, as a result, proposes a circular business model canvas.



### 5.2. Take-Back System

Material loops are the core idea of the circular economy [2,4,11]. This idea assumes that products, their components and/or materials can be cascaded (in case of biological nutrients), and reused/redistributed, remanufactured/refurbished, or recycled (in case of technical nutrients), which requires prior collecting back from the consumer and reverse logistics [4,7,24,28]. The principles of the Circular Economy applied to reverse logistics are related to take-back management, incentivized return and reuse, and collection of used products. For example I:CO is an H&M partner which collects used clothes, and Vodafone introduced the buy-back program New Every Year/Red Hot [1,76]. According to the direction of material flow in a supply chain, both forward and reverse are possible [24], but reversed logistics may require different partners, channels and customer relations, and thus a new component can be distinguished in order to differentiate the specificity of forward and reverse logistics.

### 5.3. Adoption Factors

Due to the various reasons for rejecting circular business models [5], a company must anticipate and counteract them. There are internal and external factors affecting adaptation of a business model to the circular economy principles.

Internal factors concern organizational capabilities to shift towards the circular economy business model. Such capabilities require intangible resources, like team motivation and organizational culture, knowledge and transition procedures. These components are based on developing human resources and team building, and the application of change management instruments [3,16,22,28,32,53], on using business models' design methods and tools [3,7,8,10,11,14,16,46], and evaluation models [11,22,23].

External factors comprise technological, political, sociocultural, and economic issues [53]. Technological issues pertain to the possibilities to use adequate IT and data management technologies to support material tracking [3,22,45] and other specific technologies e.g., recycling [53,54], monitoring legislation and political incentives [3,6,53], and if necessary lobbying for them [38,73]. There are crucial socioeconomic benefits justifying the efforts of lobbying for the changes of legislation and political incentives to accelerate CE [3,4,6,7,22]. Another two groups of factors concern sociocultural issues, like customer habits and public opinion, and economic forces like predictable demand for future products or previous difficulties of business entities in adoption of CE principles [11,14,16,47,53,54]. Although the list of various factors is much wider and open-ended, Roos [53] identified a list of questions supporting practitioners in adopting circularity into business models.

### 5.4. The Framework of the Circular Business Model Canvas

The circular business model canvas is extended and adjusted to the circular economy version of the business model canvas developed by Osterwalder and Pigneur [8] and others [37]. It has eleven components; however, one component encompasses three sub-components. Those building blocks allow the designing of a business model according to the principles of circular economy, and consists of:

- (1) Value propositions—offered by circular products enabling product-life extension, product-service system, virtualized services, and/or collaborative consumption. Moreover, this component comprises the incentives and benefits offered to the customers for bringing back used products
- (2) Customer segments—directly linked with value proposition component. Value proposition design depicts the fit between value proposition and customer segments
- (3) Channels—possibly virtualized through selling virtualized value proposition and delivering it also virtually, selling non-virtualized value propositions via virtual channels, and communicating with customers virtually
- (4) Customer relationships—underlying production on order and/or what customers decide, and social-marketing strategies and relationships with community partners when recycling 2.0 is implemented



- (5) Revenue streams—relying on the value propositions and comprising payments for a circular product or service, or payments for delivered availability, usage, or performance related to the product-based service offered. Revenues may also pertain to the value of resources retrieved from material loops
- (6) Key resources—choosing suppliers offering better-performing materials, virtualization of materials, resources allowing to regenerate and restore natural capital, and/or the resources obtained from customers or third parties meant to circulate in material loops (preferably closed)
- (7) Key activities—focused on increasing performance through good housekeeping, better process control, equipment modification and technology changes, sharing and virtualization, and on improving the design of the product, to make it ready for material loops and becoming more eco-friendly. Key activities might also comprise lobbying
- (8) Key partnerships—based on choosing and cooperating with partners, along the value chain and supply chain, which support the circular economy
- (9) Cost structure—reflecting financial changes made in other components of CBM, including the value of incentives for customers. Special evaluation criteria and accounting principles must be applied to this component
- (10) Take-Back system—the design of the take-back management system including channels and customer relations related to this system
- (11) Adoption factors—transition towards circular business model must be supported by various organizational capabilities and external factors

Figure 3 below presents an overview of the circular business model canvas.

<b>Partners</b> <ul style="list-style-type: none"><li>Cooperative networks</li><li>Types of collaboration</li></ul>	<b>Activities</b> <ul style="list-style-type: none"><li>Optimising performance</li><li>Product Design</li><li>Lobbying</li><li>Remanufacturing, recycling</li><li>Technology exchange</li></ul>	<b>Value Proposition</b> <ul style="list-style-type: none"><li>PSS</li><li>Circular Product</li><li>Virtual service</li><li>Incentives for customers in Take-Back System</li></ul>	<b>Customer Relations</b> <ul style="list-style-type: none"><li>Produce on order</li><li>Customer vote (design)</li><li>Social-marketing strategies and relationships with community partners in Recycling 2.0</li></ul>	<b>Customer Segments</b> <ul style="list-style-type: none"><li>Customer types</li></ul>
	<b>Key Resources</b> <ul style="list-style-type: none"><li>Better-performing materials</li><li>Regeneration and restoring of natural capital</li><li>Virtualization of materials</li><li>Retrieved Resources (products, components, materials)</li></ul>		<b>Channels</b> <ul style="list-style-type: none"><li>Virtualization</li></ul>	
			<b>Take-Back System</b> <ul style="list-style-type: none"><li>Take-back management</li><li>Channels</li><li>Customer relations</li></ul>	
<b>Cost Structure</b> <ul style="list-style-type: none"><li>Evaluation criteria</li><li>Value of incentives for customers</li><li>Guidelines to account the costs of material flow</li></ul>			<b>Revenue Streams</b> <ul style="list-style-type: none"><li>Input-based</li><li>Availability-based</li><li>Usage-based</li><li>Performance-based</li><li>Value of retrieved resources</li></ul>	
<b>Adoption Factors</b> <ul style="list-style-type: none"><li>Organizational capabilities</li><li>PEST factors</li></ul>				

**Figure 3.** A framework of the circular business model canvas. Source: adapted from Osterwalder and Pigneur [8].

### 5.5. The Triple Fit Challenge as the Enabler of the Transition Towards a Circular Business Model

The general assumption of the business model design is that all its building blocks fit each other [8]. However, the value proposition design [37] implies that some fits are more important than others, and should be considered as the key success factors for a business model. In this regard there are three main challenges to overcome in order to enable the transition from a linear to a circular business model.

The first fit is between the value proposition, including the take-back system, and customer segments [37,51]. The second fit is between the cost structure and revenue streams. Simply the costs and revenues must be balanced, and the business model should indicate possibilities for profits [56,84]. This also pertains to other cycles of selling products (e.g., reused, recycled) [18,87]. The third fit is between the changes a company implements towards more circular business model and adaptation factors which can hinder this process (e.g., [3,6,11,16,22,50,53,56,57]).

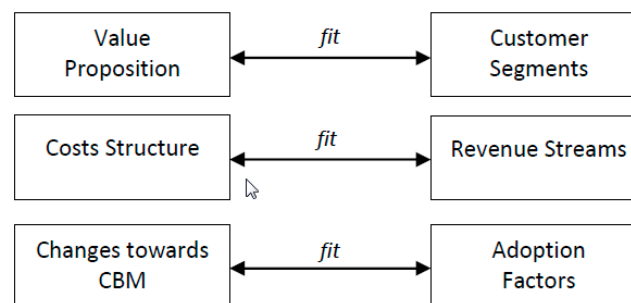


Figure 4. The challenge of triple fit.

#### 5.6. Advantages and Disadvantages of the Circular Business Model Canvas

The business model canvas developed by Osterwalder and Pigneur [8] can be used to design circular business models because every business model is to some extent linear and circular at the same time. This framework supports the process of designing a business model, but does not indicate how the principles of the circular economy or the business actions implementing CE are related to particular components of the business model. In turn, the ReSOLVE framework shows how the principles of the circular economy are translated into business actions implementing CE, but not in relation to business model components and design process. The circular business model canvas (CMBC) combines these two elements. There are some examples combining sustainability principles and business model components [88], albeit on a very general level and more useful for explanatory purposes than for supporting practitioners in designing business models. Hence, CBMC has some advantages as compared to the original canvas or the archetypes of sustainable business models.

Firstly, CMBC points out the ways of applying circularity to each component of the business model. As a result, it provides the entrepreneur with a selection of possibilities to be applied to one, several or all of the business model components. This supports different speeds of change—radical and incremental. Secondly, CMBC comprises and emphasizes additional components which are crucial to CE—take-back systems and adoption factors. Thirdly, CMBC indicates the three main challenges in the transition from a linear to circular business model, which the original canvas does not include. Fourthly, it combines the original components of the canvas with CE principles in one framework, which as a practical tool is easier and more user friendly than the triple-layered business model canvas (TLBMC) aimed to support the creation of sustainable business models [89].

There are also some disadvantages of CBMC. Due to its focus on CE principles, it is less useful in designing linear business models. Moreover, the new framework is also more complex, and thus more difficult to apply than the original one. Besides, this is a conceptualization, so its real usability in designing processes has yet to be empirically verified.

## 6. Future Research

This study was based on the literature review which implies two major limitations. First, it comprises mainly the literature related to the circular economy. Because there is some disagreement in the literature surrounding the questions whether and how circular economy and sustainability are linked and overlapping concepts [3,11], the wider literature on sustainable business models [21,41,90,91] was considered here to a lesser extent. Moreover, there is a substantial body of

literature related to each school of thought underlying the circular economy, especially industrial ecology, industrial symbiosis, industrial metabolism, and cleaner production. Each and within each of them there is enough research to conduct comprehensive review studies. Govindan, Soleimani, and Kannan's [24] study is a good example of such a review. This literature was also considered here to a lesser extent, due to intentional focus on circular economy, and inclusion of those concepts in the literature on circular economy. The second limitation of this study pertains to the lack of empirical evidence; further research could therefore focus on empirical verification of the applicability of the proposed framework of the circular business model, in various business settings, especially of the new components like retrieved value proposition which requires empirical verification and further cognition. A detailed empirical investigation of the value proposition design in the context of the circular economy would be very interesting and promising. Does value proposition design need to be adjusted to the circular economy? What are the customer's pains and gains related to the circular economy and how could a fit with value proposition be achieved? In this regard, the newest book by Osterwalder *et al.* [37] provides a good starting point to consider. Another direction could explore how the three fits (in the triple fit challenge) are interrelated. Some critical success factors for circular business models could be derived from such research. A heavily underexplored area is related to applying circularity to business models of public sector organizations and also non-governmental organizations. One of many possible routes of investigation is how the public sector and NGOs may benefit from partnerships with business [66,92].

## 7. Conclusions

There are two very vital areas of managerial practice which have recently garnered a great deal of research interest: business models and the circular economy. This study focuses on both of them, and investigates circular business models. Not many studies have been conducted on this specific topic. Most of the studies focused on a particular type of circular business model, its specificity and context. Those models are related to various schools of thought underlying the concept of the circular economy, and they appear in the literature pertaining to sustainability, industrial ecology, cleaner production, and a closed-loop economy with different names. However, most of them can be reflected by the ReSOLVE framework developed by the Ellen MacArthur Foundation. The literature also indicated numerous adoption factors, design and managerial tools, and evaluation models needed for circular business models to operate.

Regarding the design of circular business models, existing literature identified various circular business models, few business activities pertaining to the circular economy and some guidelines how to adapt existing business model to the circular economy. Yet, those studies were mostly case-based, and provided specific business models, but with limitations in their transferability. Although existing frameworks of business models can be used to apply the principles of the circular economy, hardly any study identified how the CE principles can be applied to each component of the business model framework. Hence, there is a need for a comprehensive conceptual framework for the circular business model to support practitioners in the transition of their businesses towards circular economy.

This paper addresses the issue of designing a circular business model from the perspective of every company. It identifies how the principles of the circular economy apply to a popular business model framework, and supplements this framework with additional components relevant to the circular economy. In turn, the circular business model canvas has been developed on the basis of the business model canvas. The CBMC consists of eleven building blocks, encompassing not only traditional components with minor modifications, but also material loops and adaptation factors. The triple fit challenge to implement a circular business model has been identified as a success factor. The provided framework should assist practitioners in designing circular business models; however, it requires further examination due to limitations of this study.

The conceptual framework of the circular business model proposed in this paper contributes to the discussion on implementation of the circular economy, and supports practitioners with a tool to accelerate the transition from linearity to circularity on a micro-level.

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## References

1. Ellen MacArthur Foundation. Towards the Circular Economy: Accelerating the Scale-up Across Global Supply Chains. Available online: [http://www3.weforum.org/docs/WEF\\_ENV\\_TowardsCircularEconomy\\_Report\\_2014.pdf](http://www3.weforum.org/docs/WEF_ENV_TowardsCircularEconomy_Report_2014.pdf) (accessed on 31 December 2015).
2. Ellen MacArthur Foundation. Towards the Circular Economy. Opportunities for the Consumer Goods Sector. Available online: [http://www.ellenmacarthurfoundation.org/assets/downloads/publications/TCE\\_Report-2013.pdf](http://www.ellenmacarthurfoundation.org/assets/downloads/publications/TCE_Report-2013.pdf) (accessed on 31 December 2015).
3. Scott, J.T. *The Sustainable Business a Practitioner's Guide to Achieving Long-Term Profitability and Competitiveness*, 2nd ed.; Greenleaf Publishing: Sheffield, UK, 2015.
4. Ellen MacArthur Foundation. Towards the Circular Economy: Economic and Business Rationale for an Accelerated Transition. Available online: <http://mvonederland.nl/system/files/media/towards-the-circular-economy.pdf> (accessed on 31 December 2015).
5. Planing, P. Business Model Innovation in a Circular Economy Reasons for Non-Acceptance of Circular Business Models. *Open J. Bus. Model Innov.* **2015**, in press.
6. Ellen MacArthur Foundation. *Delivering the Circular Economy a Toolkit for Policymakers*; Ellen MacArthur Foundation: Cowes, UK, 2015.
7. Van Renswoude, K.; Wolde, A.T.; Joustra, D.J. Circular Business Models. Part 1: An introduction to IMSA's Circular Business Model Scan. Available online: [https://groenomstilling.erhvervsstyrelsen.dk/sites/default/files/media/imsa\\_circular\\_business\\_models\\_-\\_april\\_2015\\_-\\_part\\_1.pdf](https://groenomstilling.erhvervsstyrelsen.dk/sites/default/files/media/imsa_circular_business_models_-_april_2015_-_part_1.pdf) (accessed on 31 December 2015).
8. Osterwalder, A.; Pigneur, Y. *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers*; John Wiley and Sons: Hoboken, NJ, USA, 2010.
9. Wirtz, B.W. *Business Model Management: Design—Instruments—Success Factors*, 1st ed.; Springer Science+Business Media B.V.: Dordrecht, The Netherlands, 2011.
10. Barquet, A.P.B.; de Oliveira, M.G.; Amigo, C.R.; Cunha, V.P.; Rozenfeld, H. Employing the business model concept to support the adoption of product-service systems (PSS). *Ind. Mark. Manag.* **2013**, *42*, 693–704. [CrossRef]
11. Mentink, B. Circular Business Model Innovation: A Process Framework and a Tool for Business Model Innovation in a Circular Economy. Master's Thesis, Delft University of Technology & Leiden University, Leiden, The Netherlands, 2014.
12. Lüdeke-Freund, F. Towards a Conceptual Framework of Business Models for Sustainability. In *Knowledge Collaboration & Learning for Sustainable Innovation*, Proceedings of the ERSCP-EMSU Conference, Delft, The Netherlands, 25–29 October 2010.
13. Dewulf, K.R. Play it forward: A Game-based tool for Sustainable Product and Business Model Innovation in the Fuzzy Front End. In *Knowledge Collaboration & Learning for Sustainable Innovation*, Proceedings of the ERSCP-EMSU Conference, Delft, The Netherlands, 25–29 October 2010.
14. De Jong, E.; Engelaer, F.; Mendoza, M. Realizing Opportunities of a Circular Business Model. Available online: <http://circulatenews.org/2015/04/de-lage-landen-realising-the-opportunities-of-a-circular-business-model> (accessed on 31 December 2015).
15. Pateli, A.G.; Giaglis, G.M. A research framework for analysing eBusiness models. *Eur. J. Inf. Syst.* **2004**, *13*, 302–314. [CrossRef]
16. Joustra, D.J.; de Jong, E.; Engelaer, F. *Guided Choices towards a Circular Business Model*; North-West Europe Interreg IVB: Lille, France, 2013.
17. Lovins, A.B.; Lovins, L.H.; Hawken, P.; June, M.A.Y. A Road Map for Natural Capitalism. *Harv. Bus. Rev.* **1999**, *77*, 145–158. [PubMed]

18. Linder, M.; Williander, M. Circular Business Model Innovation: Inherent Uncertainties. *Bus. Strateg. Environ.* **2015**. [[CrossRef](#)]
19. Ayres, R.U.; Simonis, U.E. *Industrial Metabolism: Restructuring for Sustainable Development*; United Nations University Press: New York, NY, USA, 1994.
20. Renner, G.T. Geography of Industrial Localization. *Econ. Geogr.* **1947**, *23*, 167–189. [[CrossRef](#)]
21. Boons, F.; Lüdeke-Freund, F. Business models for sustainable innovation: state-of-the-art and steps towards a research agenda. *J. Clean. Prod.* **2013**, *45*, 9–19. [[CrossRef](#)]
22. Laubscher, M.; Marinelli, T. Integration of Circular Economy in Business. In Proceedings of the Conference: Going Green—CARE INNOVATION 2014, Vienna, Austria, 17–20 November 2014.
23. Ellen MacArthur Foundation. *Growth Within: A Circular Economy Vision for a Competitive Europe*; Ellen MacArthur Foundation: Cowes, UK, 2015.
24. Govindan, K.; Soleimani, H.; Kannan, D. Reverse logistics and closed-loop supply chain: A comprehensive review to explore the future. *Eur. J. Oper. Res.* **2014**, *240*, 603–626. [[CrossRef](#)]
25. Lacy, P.; Rosenberg, D.; Drewell, Q.; Rutqvist, J. 5 Business Models that are Driving the Circular Economy. Available online: <http://www.fastcoexist.com/1681904/5-Business-Models-That-Are-Driving-the-Circular-Economy> (accessed on 31 December 2015).
26. Bakker, C.A.; den Hollander, M.C.; van Hinte, E.; Zijlstra, Y. *Products That Last—Product Design for Circular Business Models*, 1st ed.; TU Delft Library/Marcel den Hollander IDRC: Delft, The Netherlands, 2014.
27. Damen, M.A. A Resources Passport for a Circular Economy. Master's Thesis, Utrecht University, Utrecht, The Netherlands, 2012.
28. Lacy, P.; Keeble, J.; McNamara, R.; Rutqvist, J.; Haglund, T.; Cui, M.; Cooper, A.; Pettersson, C.; Kevin, E.; Buddemeier, P.; et al. *Circular Advantage: Innovative Business Models and Technologies to Create Value in a World without Limits to Growth*; Accenture: Chicago, IL, USA, 2014.
29. WRAP. Innovative Business Model Map. Available online: <http://www.wrap.org.uk/content/innovative-business-model-map> (accessed on 4 October 2015).
30. Tukker, A.; Tischner, U. Product-services as a research field: Past, present and future. Reflections from a decade of research. *J. Clean. Prod.* **2006**, *14*, 1552–1556. [[CrossRef](#)]
31. Van Ostaeyen, J.; van Horenbeek, A.; Pintelon, L.; Duflou, J.R. A refined typology of product-service systems based on functional hierarchy modeling. *J. Clean. Prod.* **2013**, *51*, 261–276. [[CrossRef](#)]
32. El-Haggar, S. Cleaner Production. In *Sustainable Industrial Design and Waste Management: Cradle-to-Cradle for Sustainable Development*; Academic Press: Amsterdam, The Netherlands, 2007.
33. Bakker, C.; Wang, F.; Huisman, J.; den Hollander, M. Products that go round: Exploring product life extension through design. *J. Clean. Prod.* **2014**, *69*, 10–16. [[CrossRef](#)]
34. Moser, F.; Jakl, T. Chemical leasing—A review of implementation in the past decade. *Environ. Sci. Pollut. Res.* **2014**, *22*, 6325–6348. [[CrossRef](#)] [[PubMed](#)]
35. Bautista-Lazo, S. *Sustainable Manufacturing: Turning Waste Into Profitable Co-Products*; University of Liverpool: Liverpool, UK, 2013.
36. Tukker, A. Eight Types of Product Service Systems: Eight Ways To Sustainability? *Bus. Strateg. Environ.* **2004**, *13*, 246–260. [[CrossRef](#)]
37. Osterwalder, A.; Pigneur, Y.; Bernarda, G.; Smith, A. *Value Proposition Design: How to Create Products and Services Customers Want*; John Wiley and Sons: Hoboken, NJ, USA, 2014.
38. Stubbs, W.; Cocklin, C. Conceptualizing a “Sustainability Business Model”. *Organ. Environ.* **2008**, *21*, 103–127. [[CrossRef](#)]
39. Roome, N.; Louche, C. Journeying Toward Business Models for Sustainability: A Conceptual Model Found Inside the Black Box of Organisational Transformation. *Organ. Environ.* **2015**. [[CrossRef](#)]
40. Gauthier, C.; Gilomen, B. Business Models for Sustainability: Energy Efficiency in Urban Districts. *Organ. Environ.* **2015**. [[CrossRef](#)]
41. Abdelkafi, N.; Täuscher, K. Business Models for Sustainability From a System Dynamics Perspective. *Organ. Environ.* **2015**. [[CrossRef](#)]
42. Jabłoński, A. Design and Operationalization of Technological Business Models. *Acta Univ. Agric. Silvic. Mendelianae Brun.* **2015**, *63*, 927–935. [[CrossRef](#)]
43. Upward, A.; Jones, P. An Ontology for Strongly Sustainable Business Models: Defining an Enterprise Framework Compatible With Natural and Social Science. *Organ. Environ.* **2015**. [[CrossRef](#)]



44. Nilsson, N.; Söderberg, V. How to Future Proof a Business Model: Capture and Capitalize Value in the Field of Urban Mining. Master's Thesis, Blekinge Institute of Technology, Karlskrona, Sweden, 2015.
45. Parlikad, A.K.; McFarlane, D.; Fleisch, E.; Gross, S. The Role of Product Identity in End-of-Life Decision Making. Available online: [www.alexandria.unisg.ch/export/DL/Sandra\\_Gross/21460.pdf](http://www.alexandria.unisg.ch/export/DL/Sandra_Gross/21460.pdf) (accessed on 31 December 2015).
46. Guinée, J.B. Handbook on Life Cycle Assessment: Operational Guide to the ISO Standards. In *Book Review: The Second Dutch LCA-Guide*; Springer Science+Business Media B.V.: Dordrecht, The Netherlands, 2002; pp. 311–313.
47. De Winter, J. Circular Business Models: An Opportunity to Generate New Value, Recover Value and Mitigate Risk Associated with Pressure on Raw Material Availability and Price Volatility. Master's Thesis, University of Utrecht, Utrecht, The Netherlands, 2014.
48. Scheepens, A.E.; Vogtländer, J.G.; Brezet, J.C. Two life cycle assessment (LCA) based methods to analyse and design complex (regional) circular economy systems. Case: Making water tourism more sustainable. *J. Clean. Prod.* **2015**, in press. [[CrossRef](#)]
49. Beuren, F.H.; Gomes Ferreira, M.G.; Cauchick Miguel, P.A. Product-service systems: A literature review on integrated products and services. *J. Clean. Prod.* **2013**, *47*, 222–231. [[CrossRef](#)]
50. Jabłoński, A. Network Dynamics and Business Model Dynamics in Improving a Company's Performance. *Int. J. Econ. Commer. Manag.* **2015**, *3*, 1–10.
51. Pearce, J.A. The Profit-Making Allure of Product Reconstruction. *MIT Sloan Manag. Rev.* **2009**, *50*, 59–65.
52. Zairul, M.; Wamelin, J.W.; Gruis, V.; John, L. New industrialised housing model for young starters in Malaysia: Identifying problems for the formulation of a new business model for the housing industry. In Proceedings of the APNHR 2015: The Asia Pacific Network for Housing Research, Gwangju, Korea, 9–11 April 2015.
53. Roos, G. Business Model Innovation to Create and Capture Resource Value in Future Circular Material Chains. *Resources* **2014**, *3*, 248–274. [[CrossRef](#)]
54. Bechtel, N.; Bojko, R.; Völkel, R. Be in the Loop: Circular Economy & Strategic Sustainable Development. Master's Thesis, Blekinge Institute of Technology, Karlskrona, Sweden, 2013.
55. United Nation Environment Programme (UNEP). *Product-Service Systems and Sustainability*; UNEP: Washington, DC, USA, 2002; pp. 1–31.
56. Besch, K. Product-service systems for office furniture: Barriers and opportunities on the European market. *J. Clean. Prod.* **2005**, *13*, 1083–1094. [[CrossRef](#)]
57. Heese, H.S.; Cattani, K.; Ferrer, G.; Gilland, W.; Roth, A.V. Competitive advantage through take-back of used products. *Eur. J. Oper. Res.* **2005**, *164*, 143–157. [[CrossRef](#)]
58. Walsh, B. PSS for Product Life Extension through Remanufacturing. In Proceedings of the 2nd CIRP IPS<sup>2</sup> Conference, Linköping, Sweden, 14–15 April 2010; pp. 261–266.
59. Firnkorn, J.; Müller, M. Selling Mobility instead of Cars: New Business Strategies of Automakers and the Impact on Private Vehicle Holding. *Bus. Strateg. Environ.* **2012**, *21*, 264–280. [[CrossRef](#)]
60. Shafiee, A.; Stec, T. Gaining a Competitive Advantage with Sustainable Business—Implementing Inductive Charging using Systems Thinking, A Benchmarking of EVs and PHEVs. Master's Thesis, Chalmers University of Technology, Göteborg, Sweden, 2014.
61. Andersson, D.; Stavileci, S. An Assessment of How Circular Economy can Be Implemented in the Aerospace Industry. Master's Thesis, Blekinge Institute of Technology, Karlskrona, Sweden, 2015.
62. Jasch, C. How to perform an environmental management cost assessment in one day. *J. Clean. Prod.* **2006**, *14*, 1194–1213. [[CrossRef](#)]
63. Jasch, C. Environmental management accounting (EMA) as the next step in the evolution of management accounting. *J. Clean. Prod.* **2006**, *14*, 1190–1193. [[CrossRef](#)]
64. Gale, R. Environmental management accounting as a reflexive modernization strategy in cleaner production. *J. Clean. Prod.* **2006**, *14*, 1228–1236. [[CrossRef](#)]
65. Sheu, J.-B. Green Supply Chain Collaboration for Fashionable Consumer Electronics Products under Third-Party Power Intervention—A Resource Dependence Perspective. *Sustainability* **2014**, *6*, 2832–2875. [[CrossRef](#)]
66. Robinson, J.; Brase, G.; Griswold, W.; Jackson, C.; Erickson, L. Business Models for Solar Powered Charging Stations to Develop Infrastructure for Electric Vehicles. *Sustainability* **2014**, *6*, 7358–7387. [[CrossRef](#)]



67. Rifkin, J. *The Zero Marginal Cost Society: The Internet of Things, the Collaborative Commons, and the Eclipse of Capitalism*; St. Martin's Press: New York, NY, USA, 2014.
68. Freyermuth, G.S. Edges & Nodes/Cities & Nets: The History and Theories of Networks and What They Tell Us about Urbanity in the Digital Age. Available online: <http://periodicals.narr.de/index.php/real/article/view/1576/1555> (accessed on 31 December 2015).
69. Waste Management. Recycling 2.0: Recycling Engagement and Education. Available online: [http://www.cafr.org/summit/speakers/ppt/2015-06-08\\_11:10:00\\_\\_Robinson\\_Susan.pdf](http://www.cafr.org/summit/speakers/ppt/2015-06-08_11:10:00__Robinson_Susan.pdf) (accessed on 31 December 2015).
70. Subramanian, N.; Gunasekaran, A. Cleaner supply-chain management practices for twenty-first-century organizational competitiveness: Practice-performance framework and research propositions. *Int. J. Prod. Econ.* **2015**, *164*, 216–233. [CrossRef]
71. Sivertsson, O.; Tell, J. Barriers to Business Model Innovation in Swedish Agriculture. *Sustainability* **2015**, *7*, 1957–1969. [CrossRef]
72. Berning, A.; Venter, C. Sustainable Supply Chain Engagement in a Retail Environment. *Sustainability* **2015**, *7*, 6246–6263. [CrossRef]
73. Skelton, K.; Pattis, A. Life Cycle Management In Product Development: A Comparative Analysis of Industry Practices Kristen. In Proceedings of the 6th International Conference on Life Cycle Management, Gothenburg, Sweden, 25–28 August 2013.
74. Pearce, D.W.; Turner, R.K. *Economics of Natural Resources and the Environment*; Johns Hopkins University Press: Baltimore, MD, USA, 1990.
75. Frankenberger, K.; Weiblen, T.; Csik, M.; Gassmann, O. The 4I-framework of business model innovation: A structured view on process phases and challenges. *Int. J. Prod. Dev.* **2013**, *18*, 249–273. [CrossRef]
76. WRAP. Innovative Business Models. Available online: <http://www.wrap.org.uk/content/innovative-business-models-1> (accessed on 31 December 2015).
77. Mahadevan, B. Business Models for Internet-Based E-Commerce: An Anatomy. *Calif. Manag. Rev.* **2000**, *42*, 55–69. [CrossRef]
78. Afuah, A.; Tucci, C.L. *Internet Business Models and Strategies: Text and Cases*, 1st ed.; McGraw-Hill College: Columbus, OH, USA, 2000.
79. Papakiriakopoulos, D.A.; Poylumenakou, A.K.; Doukidis, G.J. Building E-Business Models: An Analytical Framework and Development Guidelines. In Proceedings of the 14th Bled Electronic Commerce Conference, Bled, Slovenia, 25–26 June 2001.
80. Chesbrough, H.; Rosenbloom, R.S. The role of the business model in capturing value from innovation: evidence from Xerox Corporation's technology spin-off companies. *Ind. Corp. Chang.* **2002**, *11*, 529–555. [CrossRef]
81. Linder, J.; Cantrell, S. *Changing Business Models: Surveying the Landscape*; Accenture Institute for Strategic Change: Cambridge, MA, USA, 2000.
82. Al-debei, M.M.; El-Haddadeh, R.; Avison, D. Defining the Business Model in the New World of Digital Business. In Proceedings of the 14th Americas Conference on Information Systems, Toronto, ON, Canada, 14–17 August 2008.
83. Osterwalder, A.; Pigneur, Y.; Tucci, C.L. Clarifying Business Models: Origins, Present, and Future of the Concept. *Commun. Assoc. Inf. Syst.* **2005**, *16*, 1–25.
84. Bautista-Lazo, S.; Short, T. Introducing the All Seeing Eye of Business: A model for understanding the nature, impact and potential uses of waste. *J. Clean. Prod.* **2013**, *40*, 141–150. [CrossRef]
85. Buxel, H.; Esenduran, G.; Griffin, S. Strategic sustainability: Creating business value with life cycle analysis. *Bus. Horiz.* **2015**, *58*, 109–122. [CrossRef]
86. Saeabi, T.; Foss, N.J. Business models for open innovation: Matching heterogeneous open innovation strategies with business model dimensions. *Eur. Manag. J.* **2014**, *33*, 201–213. [CrossRef]
87. Kocabasoglu, C.; Prahinski, C.; Klassen, R.D. Linking forward and reverse supply chain investments: The role of business uncertainty. *J. Oper. Manag.* **2007**, *25*, 1141–1160. [CrossRef]
88. Bocken, N.M.P.; Short, S.W.; Rana, P.; Evans, S. A literature and practice review to develop sustainable business model archetypes. *J. Clean. Prod.* **2014**, *65*, 42–56. [CrossRef]

89. Joyce, A.; Paquin, R.; Pigneur, Y. The triple layered business model canvas: A tool to design more sustainable business models. In Proceedings of the ARTEM Organizational Creativity International Conference, Nancy, France, 26–27 March 2015.
90. Talonen, T.; Hakkarainen, K. Elements of sustainable business models. *Int. J. Innov. Sci.* **2014**, *6*, 43–54. [[CrossRef](#)]
91. Seay, S.S. How incorporating a sustainable business model creates value. *Bus. Stud. J.* **2015**, *7*, 46–61.
92. Lewandowski, M. Introduction to Academic Entrepreneurship. In *Academic Entrepreneurship and Technological Innovation*; Szopa, A., Karwowski, W., Ordóñez de Pablos, P., Eds.; IGI Global: Hershey, PA, USA, 2013.



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